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BY

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1867

COFFEE

AND

ITS ADULTERATIONS.

Of the beverages that have been introduced into the dietary lists of civilized nations since the seventeenth century, there is not one of greater importance than that which both the rich and poor find so gratifying to the palate, and so necessary for the perfection of the breakfast, or first meal. Deprived of the morning cup of coffee, throughout the day we feel a diminution in the accustomed vigor and ease with which work is accomplished, and many will seek relief from the lassitude by which they are oppressed by indulgence in some form of alcoholic stimulant.

Coffee, therefore, is of interest, not only from a physiological, but also from a moral point of view; and it consequently becomes necessary that every feasible and proper precaution should be taken to preserve it from the manifold processes of adulteration to which we shall find it is almost universally subjected. It is no justification of such adulterations that they are said to be innocuous; for even if the assertion was true, the adulterations almost invariably consist of valueless substances, which are thus palmed on the poor at an enormous profit to the seller; and the laborer is not only cheated of the stimulant and nutritive material a cup of good coffee would furnish, but his pocket is also robbed of hard-earned wages by the purchase of a worthless article, which he might himself prepare for one-third or one-fifth the price demanded.

When properly made, coffee is a solution in hot or boiling water, of certain constituents of the roasted seeds of the *coffea Arabica*, a shrub or tree of the order *Cinchonaceæ*, and a native of Southern Abyssinia, though it also grows wild in Liberia. It was first introduced into Constantinople in the middle of the sixteenth century, and coffee-houses appeared in London only in the latter part of the seventeenth century, since which time this valu-

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able beverage has come into general use in nearly all parts of the civilized world.

The appearance of the shrub or tree is described as follows, by Mr. Ellis: When in good health and full-grown, it attains a height not exceeding eight or ten feet in some countries, but in others from fifteen to twenty feet. Its bark is gray, and it is covered with a dark, smooth, shining, and evergreen foliage, the leaves being four or five inches long, of an oblong ovate form, and set opposite each other. It is sown in nurseries, transplanted when about six months old, and the growth checked by topping the plant to favor the collection of the fruit; in three months it comes into full bearing, and in favorable circumstances will continue to bear for twenty years. It flourishes best in a dry soil and a warm location; its flowers are pale, white, fragrant, hardly ever absent, and fade rapidly; its fruit like that of the cherry-tree, but it grows in clusters; the fleshy part is very palatable, and in the interior the seeds are found, each of which forms two of the grains of commerce. On dry and elevated parts the seeds are smaller, and have a better flavor, but seeds of all sizes improve in flavor, or ripen by keeping. The small grains of Arabia will ripen in three years, but the worst coffee of America will in not more than ten or fourteen years become as good, and acquire as high a flavor as the best we have from Turkey. The superiority of the Arabian seed is doubtless due in part to the fact that the planters in the region where it is cultivated, use a system of irrigation, and turn off the water from the roots when there is a large quantity of fruit nearly ripe, and do not pluck the fruit, but to insure its ripeness shake the trees and collect the berries on cloths spread to receive them.

The principal supply of the coffee consumed in the United States is derived from Brazil and St. Domingo; but there are also other varieties to be found in the New York markets, among which we may mention Mocha, Java, Ceylon or East India, and Maracaibo, La Guayra, or American or West Indian. The Mocha or Arabian coffee is distinguished by the smallness of the seed and its yellow color; Java and East Indian by its light color and large size; while the American and West Indian is intermediate in size, and has a greenish-gray or bluish-gray tint. The seeds of good quality may be distinguished by their being hard, and so heavy that they sink quickly in water; they have a faint coffee-like odor, are free from any smell of dampness or mouldiness, and possess a sweetish taste.

Though the seed is so universally employed for the preparation of coffee, it is not generally known that other portions of the plant also possess similar properties. It is stated by Mr. Ward that the natives of Sumatra universally prefer the leaf to the seed, giving as a reason that it contains more of the bitter principle, and is more nutritious. In the lowlands, coffee is not planted for the berry, not being sufficiently productive, but for the leaf, the people planting it around their houses for their own consumption.

In order to prepare the seeds for use, they are acted on by heat, in such a manner as to develop the aroma without volatilizing it. This is best accomplished by first roasting them in an open vessel to expel the water, and then completing the operation in a closed rotating roaster, in which the coffee is submitted to a brisk fire, and kept in continual movement, so that the seeds are all acted on to the same extent. The roasting should be continued until the grains are of a chestnut-brown color, and sufficiently brittle to be cracked without difficulty, but the stage of carbonization should be carefully avoided. During this operation there is a loss in weight of about twenty per cent., but the bulk increases about 50 per cent. After the roasting is completed the seeds should be allowed to cool slowly, to absorb the aroma, which may be retained, without much loss, by keeping the coffee in a well-closed vessel, from which it may from time to time be removed for use, and the solution prepared immediately after it is ground. Owing to the absorbent power of freshly-roasted and ground coffee, it may be employed as a deodorizer in the sick room, and is often used advantageously for that purpose.

PARKES recommends that the coffee served to troops in service should be previously roasted and ground, and preserved in sealed cans. The advice is no doubt good, if contractors could be trusted, but if such a system were adopted it would be next to impossible to furnish an army even with a poor article, for it would inevitably be adulterated to such an extent as to be useless. There is, however, no objection to serving it roasted and hermetically sealed in cans, as every advantage that is to be desired is gained, and but little opportunity for adulteration furnished, and soldiers would be better satisfied to crush it themselves.

The preparation for the purpose of drinking is usually by the percolator or by boiling, according to the taste and fancy of the individual. On this point the following advice by Parkes is, we think, worthy of attention:—He says: "The coffee must not be boiled, or the aroma is in part dissipated, but if made with water of one hundred and eighty or two hundred degrees the coffee only gives up nineteen to twenty per cent., whereas it ought to yield thirty to thirty-five per cent. of soluble matter. The amount, however, depends also on the kind and degree of roasting. In order to get the full benefit of the coffee, therefore, after the infusion has been poured off, the grounds should be well boiled in some more water and the hot decoction poured over fresh coffee, so that it may take up aroma; the coffee thus partially exhausted can be used on the next occasion for boiling. To clear the coffee, some cold water should be poured in from a little height; the cold water sinks through the coffee and carries down the suspended particles." The solution thus prepared has a specific gravity of about 1,010, and contains the sugar, dextrin, caffein, oil, and a part of the mineral ingredients of the berry.

The properties of this invaluable beverage are thus summed up by Pereira. It possesses powerful anti-soporific properties, hence its use as a drink by those who desire nocturnal study, and as an antidote to counteract the effects of opium, belladonna, and other narcotics, and to relieve intoxication. In those unaccustomed to its use it is apt to occasion thirst and constipation. On some persons it acts as a slight purgative. It is occasionally useful in relieving headache, especially when of a nervous type. It has also been employed as a febrifuge in intermittents, as a stomachic in some forms of dyspepsia, and as a stimulant to the cerebro-spinal system in some nervous disorders. Dr. Percival and others have used it in spasmodic diseases, as whooping-cough and asthma, and Laennec says, "I have myself seen several cases of the latter disease in which coffee was really useful." It has also been employed with advantage in hysteria. The immoderate use of coffee is said to produce nervous symptoms, such as anxiety, tremor, disordered vision, palpitation, feverishness, and not infrequently, headache.

From the general consideration of the preparation and physiological properties of coffee, we now pass to the examination of the methods employed for its adulteration. They may be classified under three heads:

1st. The mixture of superior with inferior varieties.

2nd. The mixture of good coffee with that which has been damaged by water.

3rd. The addition of exhausted coffee grounds or foreign substances, as chicory, bread, rye, &c.

The first method is, of course, the least injurious, and while the seeds are yet in the green state may generally be detected by an expert without difficulty; when they are roasted it is not so easy; and if roasted and ground, it is next to impossible to discover by any chemical or microscopic examination the extent to which the adulteration has been carried; and it is only when the article is finally prepared for use that its unsatisfactory character is detected.

The second system of adulteration, by seeds that have been damaged, may also be determined by an expert, since the grains are generally saltish, or if they have been washed in fresh water and dried, still possess an unpleasant taste, even after they are roasted. The presence of such material in roasted and ground coffee can only be detected with satisfaction by the inferior character of the solution it furnishes.

From the above passing view of the first two methods of adulteration, we turn to the third, which is by far the most important, since, in all probability, more than nine-tenths of the coffee consumed is sold to the consumer in the roasted and ground state, in which condition it is easy to introduce many foreign substances.

The tests that may be practically employed in the examination of specimens of roasted and ground coffee may be classified under two heads, 1st, the physical, and 2d, the microscopic, to which we may, if desirable, add a few chemical tests, which are, however, not of any great value, since the physical and microscopic examinations are quickly finished, and furnish all the information that is required.

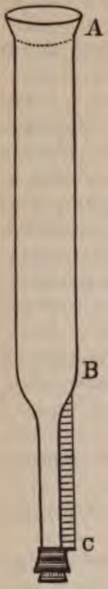
The aroma and appearance of ground coffee cannot be depended on, for they may be so manipulated as to deceive the closest observer, and in one specimen that passed under my notice during the past winter, and which possessed in perfection the aroma of freshly roasted fine old mocha, there was not a single particle of any kind of coffee, the article in question consisting of a mixture of chicory and bread or biscuit, over which the fumes of roasting mocha had probably been conducted, so as to impart the delicious aroma it possessed, and which could only have been given in some such way.

The substance generally used for the adulteration of ground coffee is chicory, which is at present furnished in the New York market, ready for use, at about fifteen cents per pound, by the quantity, a good specimen of Java in the same state costing about forty-five or fifty cents, and the inferior grades of ground common coffee being worth about 40 cents, so that the retail dealer is able, by the judicious addition of chicory, to secure a very handsome profit.

When the proportion of this substance is large it may be readily detected by the simple test recommended by Mitchell, which consists in kneading a small quantity of the specimen in the palm of the hand with a little water, when the chicory imparts a gummy feel, and if the quantity is sufficient, the mass may be made to cohere in any desired form; while, under the same conditions, a sample of good coffee fails to cohere, and crumbles to pieces when we attempt to give it form.

In order to employ the physical properties of coffee as a test of its value, I contrived the instrument represented in the adjoining figure, and have found it of great service. It affords at once a number of indications by the observation of which we can not only detect the presence of foreign substances, but also form a very good estimate of the quantity. This instrument consists of a tube (A B), one inch in diameter and eight inches in length, which terminates below in a narrow tube (B C), one quarter of an inch in diameter, and four inches in length; the lower small opening (C) is closed by means of a cork to a certain point, from which it is graduated to tenths of a cubic centimeter; a number of these tubes, with a suitable stand, and a small measure holding one cubic centimeter, complete the apparatus.

When it is to be used, the tubes are closed below, and filled to within half an inch of the upper extremity (A) with cold water (that has been boiled to expel the gas, and kept in a well stopped bottle to prevent its reabsorption). A cubic centimeter of the sample of coffee under examination is then cautiously dropped



on the surface of the water, when we should notice, 1st, whether it sinks quickly or slowly; 2d, what tint and odor it imparts to the water; 3d, the expansion in bulk as measured in the graduated tube; 4th, the change in color of the grounds, and whether they collect loosely or not.

If it is good coffee and a pure article, it floats on the surface for a considerable period, and if freshly roasted and ground will often remain suspended for days, if the tubes are kept free from agitation. In the majority of instances it falls in a few hours, and imparts to the water in the large tube a delicate amber tint and a faint coffee-like odor, each particle as it rests in the small tube retaining its outline, individuality, and color; and the increase in bulk being about one half a cubic centimeter.

If it is chicory it sinks instantly, nearly the whole mass tumbling into the small tube in a single minute, and even in its rapid passage through the water imparting to it a deep brown color, and an odor somewhat like that of liquorice; the tint of the particles is at the same time altered greatly, the expansion of the mass is also very considerable, its bulk in a short time increasing to nearly two and a half cubic centimeters; and the particles losing their individuality seem to fuse together, and form a mass without interstices.

By preparing mixtures of chicory and coffee in different proportions, we find that the first sinks rapidly, while the latter remains suspended for a considerable period; though a small portion may be carried down by the chicory in its sudden subsidence. After a time (which may be shortened, if desired, by agitating the tube), the coffee also sinks, and by noting the proportion of compact and loose sediment in the small tube, and the position of the line of meeting of the dark and light colored solution, we obtain an indication of the proportion of chicory to coffee, which coincides very nearly with that employed in making the mixture. The tint of the fluid in the large tube, and the amount of increase in the bulk of the solid matter, are also of use in arriving at a correct estimate. After the performance of a few experiments with mixtures of coffee and chicory in different proportions, a degree of expertness is obtained which enables the operator to form an accurate estimate of the amount of each ingredient in any sample that may be submitted for his examination.

Not only may coffee be thus to a great extent separated from any chicory with which it is mingled, but nearly all the other substances used for the purposes of adulteration, as exhausted coffee grounds, wheat, etc., also subside rapidly with the chicory and collect in the small tube. If it is desired to determine the character of the matter that precipitates quickly, we must resort to the microscope, when by the nature of the cells and other structures found, we can soon decide upon the true character of the foreign substances. The presence of chicory is readily and satisfactorily proved, and if peas, beans, etc., are present, they may be easily distinguished by the peculiarities of the starch cells of each. Such microscopic examinations are greatly facilitated by the use of the tubes I have described, for when the subsidence is complete, and we have read off the proportion of adulteration, it only remains to remove the cork gently from the small tube and allow a little of the lower portion of the sediment which contains the foreign matters to escape into a shallow dish, whence particles may be transferred to the microscope slide, and if it is necessary we may in this manner examine layer after layer of the deposit.

In order that some idea may be formed of the extent to which adulterations are introduced into coffees offered for sale in New York, I give a few of the results obtained in the examination of samples taken from different coffee stores during the past winter:

a 40 cent coffee, 50 per cent. adulteration, consisting of chicory and wheat.

b 30 cent coffee, 30 per cent. adulteration, consisting of chicory and wheat.

c 20 cent coffee, 50 per cent. adulteration, consisting of a little chicory, wheat, and beans.

d 18 cent coffee, 75 per cent. adulteration, consisting of a little chicory, wheat, and beans.

e 30 cent coffee, 50 per cent. adulteration, consisting of chicory.
f 40 " " 25 " " " " "
g 38 " " 33 " " " " "
h 40 " " 50 " " " " "
i 50 " " no adulteration.
j 40 " " all chicory.
k 45 " " 25 per cent., fell rapidly; was probably exhausted grounds.

l 45 cent coffee, no adulteration, was an inferior coffee.

m 50 cent coffee, no adulteration, was a good coffee.

All the above specimens were sold under attractive titles, with the exception of *i* and *m*, which were advertised as Java coffee, and from the character of the solution they furnished, I have no reason to doubt the statement of the sellers, who were respectable grocers. Out of the thirteen samples quoted above, nine contained chicory, four contained wheat, and two contained beans. The percentage of these foreign substances was so large, that the profit to the seller was very great, and in some of the instances the beverage furnished was utterly valueless.

In the specimens in which wheat was found, it is my impression, from the manner in which they acted in the tube, that the adulteration consisted of spoiled biscuit and refuse bread, which could be obtained for a mere trifle. In one specimen not given above, there were masses which presented the appearance of liver altered

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by roasting, and which is said by Hassall to be extensively used in London in the adulteration of coffee. Other specimens presented structures with which I am not acquainted, but which were evidently organic in their origin.

In addition to the substances spoken of in this paper, Hassall mentions corn, potatoes, turnips, and sawdust. These I have thus far failed to find in the samples that have passed under my notice, and which were obtained from different parts of our city, the favorites among our dealers being chicory, bread or biscuit crumb, rye, and beans. These are, of course, obtained at the cheapest rates, and must usually be refuse, which cannot be sold for any other purpose than that of being roasted, crushed, and manipulated into an article to be sold to the poor, who, thinking they cannot afford to buy an expensive coffee, give away their money to the dealer for useless refuse, and the government is defrauded of the revenue it should have collected as importation tax.

In conclusion, it is important to revert to the statement that these systems of adulteration are innocuous, and therefore not worthy of attention, except in so far as they defraud the poor and the revenue. We must not accept such an opinion too hastily, for coffee is not only used as a beverage, but it is also at times a most important and valuable medicinal agent; as, for example, in poisoning by opium, belladonna, and other narcotics. If, in such cases, the antidote ordered by the physician fails to produce its proper effect, on account of the general system of adulteration to which it is subjected, such manipulations become criminal, and can only be corrected by compelling the sellers, under penalty of a fine, to state the true nature of the substance they furnish.

Where rye is used, it is evident that only a poor article is employed, and nothing is more likely than that spurred grain may be thrown into the roaster, when if the roasting is imperfect, a sufficient quantity may escape the action of the heat to produce very disastrous effects on the systems of pregnant women, or may perhaps cause the mortifications which by many are supposed to result from the continued introduction of ergot into the system. Roasted chicory-root is also to be condemned, for it is by no means as harmless as some would have us think, for at first it generally produces nausea; and the statement of Johnston, that when taken frequently in small quantity it causes severe dyspepsia, is one that I have verified by my own experience. From these facts we may fairly conclude that the adulteration of coffee is neither justifiable nor harmless, and the sale of such mixtures under the name of coffee should be prohibited by suitable means. If the public will still insist on purchasing useless and injurious substances for the preparation of a beverage, let them be sold under their proper names, so that when coffee is wanted for ordinary use, or needed for medicinal purposes, the procuration of a good sample may be within the bounds of possibility.

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